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# Commitment and evolution

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*Document Version*
Publisher's PDF, also known as Version of record

*Publication date:*
2007

Link to publication in University of Groningen/UMCG research database

*Citation for published version (APA):*
Back, I. (2007). *Commitment and evolution: connecting emotion and reason in long-term relationships*. [Thesis fully internal (DIV), University of Groningen]. s.n.

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# Chapter 1

# Introduction

*"We may call the part of the soul whereby it reflects, rational; and the other with which it feels hunger and thirst and is distracted by sexual passion and all the other desires, we will call irrational appetite, associated with pleasure in the replenishment of certain wants...*
*What of that passionate element which makes us feel angry and indignant? Is that a third, or identical in nature with one of those two?"*

*—Plato, The Republic*

The tendency to establish lasting personal relationships is a fundamental aspect of human sociality. Throughout life we build friendships, collect acquaintances, forge business alliances, become attached to intimate partners. Many of these relationships follow us through our lives and integrate us into a complex social fabric of interpersonal connections. At the same time, establishing and maintaining long-term relationships involves substantial investment of one's time, effort and other resources. Moreover, many relationships by definition require exclusivity. For example, we can only have one best friend at a time, in many cultures only one spouse, and in many business settings only one supplier of some product. To a certain extent all relationships, i.e. non-exclusive ones as well, are competitive with each other, given that we have finite attention and resources. This means that we occasionally have to forgo relationships with potentially better alternative partners. And to complicate matters, even when we do our best to invest in a relationship, we have to live with the risk of being dumped for someone else or unknowingly being taken advantage of by our partner.

Why do people establish and maintain long-term relationships when these are costly, risky and exclusive? A simple but powerful answer from rational

choice theory is that it is in their best interest to do so. More precisely, people become committed to each other if and only if the benefits of having a relationship outweigh its maintenance costs and its alternative costs. In particular, having a long-term relationship with a partner provides valuable information about the trustworthiness of the partner compared to other partners (trust explanation, see Kollock, 1994; Yamagishi and Yamagishi, 1994; Yamagishi et al., 1994) and at the same time creates a strategic incentive to cooperate in order to avoid retaliation and stabilize long-term mutual collaboration (reciprocity explanation, see Trivers, 1971; Friedman, 1971; Axelrod, 1984; Fehr and Schmidt, 1999; Fehr and Gächter, 2002; Falk et al., 2001).

But at the same time, there seems to be much more to long-term interpersonal relationships than just trust and reciprocity. There are numerous cases, for example, when people keep relationships even after their partner has proved to be untrustworthy (e.g. Roy, 1977; Strube, 1988; Rusbult and Martz, 1995). There are also examples of relationships where a partner has no means of reciprocating in the future (e.g. Monahan and Hooker, 1997). What is it that makes battered wives return to their abusive husband when there are hardly any prospects for change? And why does someone take care of a lifelong partner with Alzheimer's disease who will never be able to recognize the caretaker? Why do subjects in controlled laboratory experiments give costly gifts to their long-term exchange partners when their identity will never be revealed to each other?

A great wealth of empirical evidence suggests that people are engaged in long-term relationships with their full emotional repertoire (cf. Baumeister and Leary, 1995). People create social relationships with great ease even in the absence of materialistic benefits or other ulterior motives, and strongly resist the dissolution of these relationships, well beyond rational considerations of practical advantages. Many of the strongest emotions people experience in their life, both positive and negative, are linked to long-term relationships. The evidence suggests that being accepted, included, or welcomed leads to positive emotions such as happiness, elation, contentment, and calm, whereas being rejected, excluded, or ignored leads to anxiety, depression, grief, jealousy, and loneliness, etc. Indeed, the evidence is sufficiently broad and consistent to suggest that one of the basic functions of emotion is to regulate behavior so as to form and maintain social bonds (Baumeister and Leary, 1995).

There is further evidence that people observe and evaluate alternative partners with a biased vision, systematically dependent on how committed their current relationship is (Johnson and Rusbult, 1989). Moreover, we know that even in anonymous exchange settings, positive emotions develop toward frequent exchange partners, and toward the relationship itself, being perceived as an object of value (Lawler and Yoon, 1996). These emotions provide a positive feedback for commitment behavior and lead to a systematic divergence from instrumental rationality.

But why is it that our relationship-related emotions are so often out of tune with what is usually regarded as rational? What is the source of emotions that make us consistently more committed than our best interest seems to dictate? Is there, in fact, something fundamentally rational behind seemingly irrational commitments?

In order to resolve the paradox between rational and emotional explanations of interpersonal commitment, we put forward an evolutionary explanation. During countless years of prehistoric evolutionary adaptation in the human ancestral environment, people lived together in small groups and fought for daily survival in a world more hostile than today's (Sterelny, 2003). With many of the formal and informal helping institutions of modern society missing, people had to rely on interpersonal relationships to a much larger extent than today. Sometime during the Pleistocene epoch (roughly 1.8 million years to 12 thousand years before the present) humans moved from rain forests to the savannah, which increased the need for collective hunting and mutual protection from large predators. This in turn created a selection pressure for increased social complexity (c.f. Smaniotto, 2004). At the same time, life-threatening situations produced more opportunities for bonding and deep friendships. Being capable and willing to establish and maintain long-term stable relationships substantially increased one's survival and reproductive chances. As a consequence, those whose cognitive arsenal was equipped with better tools and stronger preferences for making interpersonal commitments gradually increased their presence in the population over many generations (cf. Nesse, 2001a).

In lack of a direct test, evolutionary theories are difficult to empirically falsify and therefore problematic to find convincing support for. Therefore, our strategy in this dissertation is twofold. We first examine a theory of natural selection acting on commitment in closer detail in Part I (An ultimate explanation)[1]. The main motivating question for this effort is: Could a trait of interpersonal commitment have been selected for in human evolutionary history, especially in the face of other, more or less cooperative, traits? Building on previous work (especially de Vos et al., 2001) that relies on anthropological knowledge about conditions of the human ancestral environment, we create formal computational models of the ancestral environment. The purpose of these models is to test the internal consistency of an evolutionary theory about deeply rooted (or "hardwired") emotions that facilitate interpersonal commitments.

Then, in Part II (Proximate explanations) we move on to empirically test the existence of an evolved commitment trait. The main question this part addresses is: Are there features of contemporary social behavior that are in line with an ancestral trait for commitment but cannot readily be explained by

[1]See more about the important distinction between *ultimate* and *proximate* explanations in evolutionary theory under Section 1.2.1 of this chapter.

simpler, existing theories? In order to test the existence of such a proximate mechanism (which we term the commitment bias), we conducted laboratory experiments at six locations in three different countries (the Netherlands, USA and China). In particular, we aimed to find support for mechanisms that are difficult to reconcile with current exchange theoretical and (social) psychological theories but become intelligible in light of the evolutionary explanation.

In the remainder of this introductory chapter we are first going to clarify an important issue about the use of the word commitment. We then address the vast literature of commitment from philosophy, economics, game theory, exchange theory, psychology, sociology, and evolutionary psychology, pointing to how the dichotomy of emotional and rational explanations permeates the subject throughout these disciplines. Building on this broad background, we set out to construct an evolutionary theory that aims to bring the two sides of the dichotomy closer to each other and thus present the diverse literature of commitment in a new light.

### 1.0.1 A brief word on "commitment"

Before we turn to the substantial discussion of commitments, a brief clarification of the term itself is inevitable. The word "commitment" is used excessively in different meanings, within different contexts, which may lead to misunderstandings. It also creates seemingly unrelated research lines in various disciplines across the humanities and behavioral sciences. The first known record of the word entering the English language is from 1386, when Geoffrey Chaucer advised "commit the keeping of your person to your true friends..., who are the best «physicians» and most reliable help and healing" (Wyatt, 1999).

Thus, in its original sense, commitment is a promise or threat, pledge, agreement, contract or dedication, made to oneself or to others, to do something or to act in a certain way in the future. "Being committed to protect one's country from enemies" or "committing oneself to not getting married" are examples. Commitment in these cases is similar in meaning to persistence or consistence (see Section 1.1.1 "Commitment to a course of action" below).

By extension of meaning, commitment came to refer to a bond, or loyalty toward a social entity, such as an organization, a group of people, or another person. The basis for this extension is that in such cases one acts in accordance with one's expressed or understood promise to the entity, and membership therein. A friendship, a marriage vow, an employment contract, or simply refraining from extra-couple romance are examples. Commitment in this sense is related to meanings of belonging, stay behavior, loyalty or faithfulness (see Section 1.1.2 "Interpersonal Commitment" below).

Arguably, these different meanings are not independent, and a closer look reveals a number of common characteristics. Firstly, commitment always re-

quires behavioral consistency, in other words acting repeatedly in the same way with regard to the target of commitment. Secondly, commitment entails opportunity costs for the individual due to sacrificing potential rewards from alternative courses of action, that are not explored due to behavioral consistency. Finally, commitment is always temporally embedded – it has a duration in time, or at least it is in some sense about the future. It is by definition continuous in time because one cannot uphold the same commitment in disjoint fractions of time.

Given these conceptual similarities behind different forms of commitment, it is surprising that hardly any interdisciplinary research has systematically explored links between commitment in the action and in the interpersonal sense. This is not our major undertaking either but as we will demonstrate through a brief literature review below, there is at least one crucial point on which most theories of commitment converge. This common point is the duopoly of two competitive explanations: one that advocates rational reasons and another that points to deeply rooted emotions. Ignoring either type of explanation leaves a theory potentially vulnerable to criticism by the other side. Our goal is therefore to derive and test hypotheses within an evolutionary framework that is able to accommodate both types of explanations and resolve some of the contradictions arising between them within the context of interpersonal commitment.

## 1.1 Background

The idea of interpersonal commitment is conceptually embedded into the more general notion of *commitment to a course of action*. To identify the implications of the more general concept for the more specific, we start our theoretical discussion with this broader idea of commitment. From here we proceed to our core topic of interpersonal commitment, the tendency to maintain long-term relationships. The existing literature of interpersonal commitment can be separated into two, largely disconnected fields. The first field, researched mostly by economists, focuses on exchange and social networks. The second, researched mostly by psychologists, is more directed at close relationships, such as married and romantic couples. We review some of the most important contributions within each field, pointing to the presence of the emotion-rationality dichotomy throughout. Finally, we briefly touch upon a hybrid area, organizational commitment, which is closest to business and management research, although it originally grew out of the psychological field of interpersonal commitment.

### 1.1.1 Commitment to a course of action

Committing ourselves to a course of action means that we voluntarily give up some of our freedom of choice, by agreeing to do (or not to do) something at some point in the future. The willingness to make such commitments has long intrigued scientists and philosophers alike, going back as far as ancient times. The paradoxical benefits of this seemingly self-defeating behavior was already recognized by ancient Greeks. Xenophon, a talented general, when facing a superior enemy, ordered his troops to take up a position with their backs to an impassable ravine (cf. Schelling, 2006) in order to eliminate all their routes of escape. By doing so he signaled both to the enemy and to his own men that there was no alternative for survival, except victory.

A major theoretical advance came in 1785 with Immanuel Kant's "*Grundlegung zur Metaphysik der Sitten*", where he proposed to distinguish between two sources of commitment (cf. Levinger, 1999). He argued that commitment, on the one hand, can grow out of *desire* or affection. In the case of commitment of desire, people act out of inclination, for example, because they like to or enjoy it. Kant considered this type of commitment transient and therefore weak and untrustworthy. The other form of commitment stems from duty or *moral obligation*, in which case people act in accordance with principles. Kant argued that this type of commitment is more enduring and far better morally.

With this theoretical distinction between "having to" and "wanting to", Kant essentially created the fundamental dichotomy between rational and emotional explanations that still dominates the discourse over commitment.

The next major contributor to the theory of commitment was Thomas Schelling with his seminal book "*The Strategy of Conflict*" (1963). For Schelling, commitment is a strategic tool, deliberate action, the purpose of which is to influence someone else's choices. Schelling recognized the importance of being able to make commitments in situations where each actor's outcome mutually depends on other actors' actions. In such situations each actor needs to take into account what others are likely to do next. The fact that one makes a commitment to act in a certain way radically alters the expectations and decision processes of others (Schelling, 2006). The very possibility to make commitments is a key mechanism for achieving collectively desirable outcomes that are otherwise difficult to agree on (see e.g. Raub, 2004).

According to Becker's side-bet theory (1960), making a commitment links investment in an extraneous interest (a side-bet) with a consistent line of action. In Becker's example, a man wants to buy a house. The man makes an initial offer of sixteen thousand dollars to the owner. The owner insists on having twenty thousand. Our well-prepared buyer, however, reaches into his pocket to produce certified proof that he had made a bet of five thousand dollars with a third-party that he will not pay more than sixteen thousand for the house. The seller has no choice but to accept the buyer's standpoint.

In this example, the buyer uses a "credible threat" (a commitment) to modify his own payoff structure, thus also modifying the strategic interdependence between the two. Becker's theory has received extensive attention, and was widely tested empirically, albeit with mixed success (cf. Cohen and Lowenberg, 1990; Wallace, 1997). Another conceptualization of side-bets is voluntary hostage posting (e.g. Raub, 2004). Hostage posting means surrendering an object of value to a trustor in order to increase trust in the trustee's willingness to uphold the promise (commitment) made to the trustor. The hostage promotes trust (at least in the economic sense) by binding the trustee through reducing his incentives for abusing trust, by providing compensation for the trustor in case trust is abused, and by serving as a signal for the trustor about unobservable characteristics of the trustee that are related to the trustee's opportunities and incentives for abusing trust (Raub, 2004; Snijders and Buskens, 2001).

An interesting case of commitment is the tendency to escalate investment in a failing course of action, in other words, "throwing good money after bad" (cf. Karlsson et al., 2005; Brockner, 1992; Staw, 1976, 1997). Also known as the *sunk cost effect*, this motivates people to continue investment in a project despite unsuccessful prior investments of money, effort, or time (Arkes and Blumer, 1985). It is important to recognize that thinking in terms of sunk costs is a departure from rational calculation, in the sense that it distorts actual costs and benefits associated with possible outcomes.

### 1.1.2 Interpersonal commitment

Interpersonal commitment, or becoming committed to long-term partners, is regarded as a special case of *commitment to a course of action* by some game theorists, economists and also others (cf. Frank, 1988; Nesse, 2001a). The core idea behind this association is that commitment in long-term relationships is based on an implicit or explicit *promise* to stay with the partner, and to uphold a general conduct that is aligned with the interests and expectations of the partner.

This dissertation focuses on long-term interpersonal relationships, such as marriage, friendship and acquaintanceship, asking the question: why do people become committed to each other when it is seemingly not in their best interest? Just as commitment to uphold a certain course of action entails a seemingly irrational decision to reduce one's set of available choices in the future, interpersonal commitment involves sacrificing interaction with potentially superior, alternative partners. Yet, as the former type of commitment proves to be not only rational but, in fact, essential for success in society, could the same be said about interpersonal commitment? The tentative answer is yes.

**Commitment, exchange and uncertainty**

In social exchange, two or more actors exchange some form of material or social benefit among each other in order to arrive at an advantageous outcome. Exchange theory presumes that people exchange repeatedly with the same actors when success occurs but move to others when failure occurs. The underlying mechanism may be simple reinforcement learning (Homans, 1961; Emerson, 1972; Macy and Flache, 2002) or rational choice (Kollock, 1994; Cook and Whitmeyer, 1992).

Exchange often motivates actors to unilaterally modify the balance of exchange to their own advantage without prior knowledge of the partner, in other words to cheat them in some way. This inevitably leads to uncertainty about the outcome of the exchange for both partners. When actors repeatedly exchange resources, they learn more about one another, find each other more predictable, develop mutual trust, and infer that they have similar orientations to the exchange task (Lawler, 2001). Therefore, a standard insight of exchange theory is that frequent exchange with the same partner reduces uncertainty about cheating, and thus decreases the likelihood of exchanging with strangers.

More specifically, the uncertainty-reduction hypothesis was tested by Kollock (1994) who showed that commitment is more likely to form in markets where the quality of the products is unobservable at the time of the exchange. Kollock (1994) also simulated different market environments under controlled laboratory conditions. In one condition (high uncertainty), sellers could deceive their potential buyers about the quality of the product they were selling. In the other condition (low uncertainty), it was not possible to deceive buyers. A key finding of Kollock's experiment was that commitment formation between a particular seller and a particular buyer occurs more frequently in the high-uncertainty condition than in the low-uncertainty condition.

In the same vein, Yamagishi and Yamagishi (1994) argue that committed relations give a solution to the problem of uncertainty, for multiple reasons. First, committed partners accumulate information about each other over time. Second, mutually committed people enact "hostage-taking" behaviors (Raub, 2004) – ranging from the formation of mutual emotional attachments to the establishment of relation-specific assets (Helper and Levine, 1992). Hostage-taking behaviors provide deterrence against unilateral defection (Shapiro et al., 1992). Finally, conditionally cooperative strategies such as Tit-for-Tat can be used to control each other's behavior (Axelrod, 1984).

The main underlying argument for the uncertainty hypothesis is that individuals tend to avoid unpredictable or uncertain decision contexts (Tversky and Kahnemann, 1974; Kahneman and Tversky, 1979, 1996), which are created by a lack of first-hand knowledge about a potential partner's trustworthiness ("social uncertainty"). But is the trust problem the only source of

uncertainty in social exchange? Different exchange partners have different resources and may offer different benefits. The size and range of these potential benefits leads to a conceptually new source of uncertainty. Does this kind of "resource uncertainty" also increase commitment, independently from social uncertainty? We will examine the question of resource-inequality between exchange partners more closely in Chapter 4, and return to the concept of resource uncertainty in Chapter 6.

Yamagishi and Yamagishi (1994) list several reasons for the difficulty people have in leaving a committed relationship even when it becomes a liability. One is that the mutual attraction and loyalty that have developed through the relationship keep partners together. Another is that a temporary better offer from outsiders may not be sufficient for someone who has already invested in relation-specific assets to leave the current relationship. Social and psychological assets, such as the warm memory of a pleasant past and mutual understanding, may be considered relation-specific assets that keep people in these relationships. Finally, commitment to a particular partner often reduces the level of trust in "outsiders" (see Kiyonari and Yamagishi, 1996, for experimental support), creating a vicious cycle of distrust of outsiders: those who do not trust "outsiders" tend to stay in committed relationships, and because they avoid "outsiders" they become even less trusting of "outsiders."

Yamagishi et al. (1998) further connect the tendency to form a committed relationship with the individual's low level of general trust in others. They show in a cross-cultural setting (comparing the USA and Japan) that those who have high trust in others in general are less likely to form committed relationships. In Chapter 5, we follow up with a cross-cultural study (comparing the USA, China and the Netherlands), which shows that simple mere exposure is sufficient to increase commitment, even without an actual solution to the trust problem.

Yamagishi et al. (1998) argue that general trust (or trust in people in general) provides a psychological springboard for people who have been "confined" to committed relationships to move out into the larger world of opportunities. However, as we argue in Chapter 6, general trust addresses only one of the concerns about switching to new partners. It mitigates concerns about social uncertainty, but not about resource uncertainty. On the psychological level, a different antidote is required for resource uncertainty, such as general optimism. We argue that general trust and optimism together serve as two mechanisms that help people to explore new relationships with strangers, thus decreasing commitment.

Next to the uncertainty reduction mechanism, exchange theorists have recently started to recognize the importance of emotions in exchange commitments. Ed Lawler, the main proponent of the emotion argument postulates that in repetitive exchange, groups and relations become salient social objects that have a cognitive or subjective reality to actors (Lawler et al., 2000; Lawler,

2001). As such, these relations or groups may take on objective value and become ends in themselves (cf. Lawler and Yoon, 1996).

Lawler and Yoon (1996) contend that success at exchange makes people feel good, while failure makes them feel bad. Their theory of relational cohesion states that individually felt emotions unleash a cognitive process through which the emotion is attributed in part to the relation or group that constitutes the context of the exchange. In this way, groups can become objects of intrinsic value to actors due to the positive emotions generated from exchange.

### Commitment in close relationships

A special case of interpersonal commitment is close relationships, such as marriage and intimate partnership. Close relationships research has been the realm of psychology and social psychology, and so it is little wonder that it has identified the duality of emotional and rational explanations much earlier.

Many studies in close relationships psychology refer to this duality as attraction and constraints (Adams and Jones, 1999). According to Goode (1960), the attraction (or "positive pull") aspect is strong for example in romantic couples having a mutually satisfying and harmonious relationship. Both partners actively work together to ensure the future of the relationship. On the other hand, a constraining mechanism could similarly produce stay behavior. Even a marriage that exhibits no attraction anymore for either partner could nevertheless continue to exist due to external reasons, such as the sake of children's well-being or to uphold appearances in a society where divorce is unacceptable (an "empty shell" marriage in Goode's terms).

Hinde (1979) creates a similar dichotomy when he distinguishes endogenous from exogenous commitment. Endogenously committed people strive to maximize the outcomes of their relational partner, even at the cost of their own interest. In contrast, exogenous commitment is based on the legal and social environment in which the relationship is embedded.

In marriage commitment, Johnson (1973; 1991) introduces a third aspect by distinguishing between personal, structural (constraint) and moral-normative commitments. Personal commitment is the individual preference for staying in the marriage (because one *wants to*); structural commitment comes from avoiding negative consequences of the dissolution of the relationship (because one *has to*). Finally, moral-normative commitment arises from a sense of obligation, to do the right thing, to uphold personal behavioral consistency (because one *ought to*). A key psychological source of moral-normative commitment is the avoidance of cognitive dissonance – divorce may be in conflict with one's view about marriage, or having made a public declaration through marriage vows. Another source is a sense of obligation to one another, regardless of what others think: one may want to remain true to the promise made in the wedding vow.

From our perspective of an emotional-rational dichotomy in commitment, moral-normative commitment occupies a special position. It could be classified under rational explanations, simply as a factor that modifies instrumental properties of outcomes within a deliberative thought process. On the other hand, it could be part of an emotional explanation, inasmuch as norms are internalized and modify the emotional preferences of the individual.

Within interpersonal relationship research, it is perhaps Rusbult who comes closest to establishing a rational choice framework for commitment. Building on Becker's side-bet theory (1960) and Blau's work on commitment (1967), Rusbult created an investment theory for interpersonal commitment (1980; 1983). According to the investment theory, the level of commitment to a relational partner is determined by multiple interconnected factors, such as relational satisfaction (the ratio of rewards and costs in the relationship), the quality and availability of alternatives or alternative states (e.g. singleness), and prior investment in the relationship. Having a highly rewarding relationship increases commitment, but so does not having satisfactory alternatives.

Yet, in other works, Rusbult gives implicit indication that a rationality framework is insufficient to explain many aspects of interpersonal commitment. Johnson and Rusbult (1989) show, for example, that people unconsciously devalue potential alternatives the more committed they are to their current partner. Doing so, people distort key variables of a rational choice equation.

**Organizational commitment**

A large body of research studies commitment to organizations. In the discourse of organizational commitment, commitment refers to the attachment of a member or employee to an organization. It is sometimes used interchangeably with other concepts, such as cooperativeness and stay behavior, or even more broadly, organizational citizenship behavior (see Moorman and Blakely, 1995; Organ, 1988).

Organizational commitment research is largely motivated by the insight that members who are more committed, will perform better and regard the interest of the organization as common with their own, are less stressed, and less likely to leave the organization.

Meyer and Allen (1991) integrated many of the divergent conceptualizations and measurements of commitment into a coherent theoretical framework. Their model is based on the recognition that there are three main aspects (or "mindsets") of organizational commitment:

1. *Affective Commitment* is the employee's emotional attachment to the organization. It refers to identification with the goals of the organization and a desire to remain a part of the organization. The employees commit

to the organization because they "want to". In developing this concept, Meyer and Allen drew largely on Mowday et al.'s (1982) concept of commitment.

2. *Continuance Commitment* lies behind the commitment of an individual who perceives high costs of losing organizational membership (cf. the side bet theory, Becker, 1960), including economic losses (such as pension accruals) and social costs (friendship ties with co-workers) that would have to be given up. The employees commit to the organization because they "have to".

3. *Normative Commitment* is created by feelings of obligation to the organization. For instance, the organization may have invested resources in training an employee who then feels an obligation to put forth an effort on the job and stay with the organization to repay the debt. It may also reflect an internalized norm, developed before the person joins the organization through family or other socialization processes, that one should be loyal to one's organization. The employees stay with the organization because they "ought to".

According to Meyer and Herscovitch (2001), an employee has a "commitment profile" at any point in time that reflects high or low levels of all three of these factors, and different profiles have different effects on workplace behavior such as job performance, absenteeism, and the chance to quit.

These three factors are thought to jointly determine the overall level of an employee's commitment to the organization Meyer and Allen (1991). Compare how similar this trichotomy is to Johnson's model above (1973; 1991) under "Commitment in close relationships".

## 1.2 Toward an evolutionary explanation

With the advent of sociobiology, and later the rapid growth of evolutionary psychology, many aspects of human behavior have been convincingly explained from an evolutionary perspective, relying on dynamics of genetic and cultural evolution.

The major argument of evolutionary psychology (see Cosmides, 1989; Cosmides and Tooby, 1993) is that human ancestors spent a vast amount of time in a relatively stable environment of the Pleistocene, starting 1.8 million years ago and spanning until about 12,000 years ago. During the time spent in this ancestral environment, human brains and some of the most fundamental sociocultural institutions respectively, underwent a long adaptation process.

During evolutionary adaptation (Darwin, 1859), the characteristics of an individual (*trait*) undergo random changes (*mutation*) that are inherited by

their offspring. Through mutation new traits may appear, increase in strength or disappear[2]. When the combination of traits (*phenotype*) of an individual increases reproductive success relative to other individuals, i.e. by increasing the chances of the individual surviving until a reproductive age, the traits of this individual become more prevalent in the population, through the relative increase in the number of offspring possessing the trait (*natural selection*). Traits that specifically increase mating opportunities, usually through some highly observable physical trait (e.g. the peacock's colorful tail) may spread even faster (*sexual selection*).

This process led to the stabilization of those cognitive abilities and social preferences which solved problems frequently encountered in our prehistoric ancestral environment. Due to rapid changes in our civilization in the last few millennia, many of these stable adaptations are no longer beneficial but nevertheless continue to influence the behavior of contemporary humans. One example is that, although an estimated 132,687 people sustain gunshot wounds that result in death or emergency treatment in the USA annually (Beaman et al., 2000), and only a handful of people are killed or injured by snakes and spiders, people learn to fear snakes and spiders roughly as easily as a pointed gun, and much more easily than an unpointed gun, rabbit or flowers (Öhman and Mineka, 2001). The explanation from evolutionary psychology is that snakes and spiders were a large threat in the ancestral environment but guns, rabbits and flowers were not.

Several attempts have been made to construct a similar evolutionary explanation for commitment (in the general sense of promises and threats) that brings together the emotional and rational sides. As one of the main proponents of this line, Nesse (2001a), puts it:

> [There are] abundant examples of the importance of commitment in human social life. The evidence is so compelling that one cannot help but wonder why explanations for cooperation have been so narrowly dependent on methodological rationalism and individualism. I suspect the reason is the absence of a framework that can account for actions that seem irrational. In the framework of commitment, such behaviors are not only explicable, they are expected. Certain emotions seem opposed to reason because they are opposed to reason. In the short run they seem mysterious, but in the long run on average they give advantages that shape psychological traits that change the structure of human society. These psychological traits must be incorporated into our model, however difficult that may be (p. 161).

[2]Note that according to the theory of cultural evolution (Boyd and Richerson, 1985) such an evolutionary process need not take place on a genetic level. They showed that culture can evolve by a very similar dynamic as genetically based traits evolve by natural selection. Culture also undergoes mutation, individuals have cultural offspring, etc.

The answer he proposes is to regard deep rooted emotions related to commitment (to an action) as evolutionary adaptations that serve a good purpose in general and in the long run but due to their hardwiring easily come in conflict with rational deliberation.

He argues that the parts of the human brain that evolved latest in our history, the frontal lobes, closely match the abilities needed to use commitment strategies (p. 34). It appears that the frontal lobes are especially well-suited to calculating trade-offs between short-term costs of giving up options and long-term benefits that may or may not be obtained. Such calculations are inherently complex, because they involve considerations about social capital, and would be impossible without specialized mental hardware. According to Nesse, the frontal lobes are also involved in the ability to empathically identify with another person, which is essential to predicting whether the other will fulfill a commitment.

The weakness of Nesse's argument is that it attempts to cram too much under the explanatory umbrella of natural selection. In his book, he integrates works from psychology, game theory, ethology, law, medicine, religion and mythology. Doing so, his argument gets fragmented and lost in the myriad aspects of general commitment. In the end, some of the phenomena and mechanisms considered can only be linked to natural selection through smaller or larger jumps in the argument. In fact, Nesse tries to explain human cooperation and non-kin altruism arguing for a capacity for making threats and promises (commitment in the broad sense) in general, but his argument relies heavily on long-term relationships (commitment in the interpersonal sense). It could possibly strengthen his theory if the evolutionary argumentation were restricted only to the simpler and more specific idea of interpersonal commitment.

Another proponent for the crucial role of emotions in commitment is Robert Frank. In his seminal book "*Passions within Reason*" (1988) he argues that social environments naturally produce situations where commitment could potentially play a pivotal role, yet there is little room for formal commitment devices, such as contracts or other tangible hostages. In these cases, the best solutions are emotional commitments. One of the social emotions Frank argues for, as a relatively hard-to-fake signal of commitment, is *sympathy* (Frank, 2001). Sympathy enables people to detect other's emotional state and experience it to some extent. Detecting sympathy in others helps to make promises about future cooperation more credible.

Another social emotion that makes commitments credible without tangible assurances is *anger*. In a world of purely rational self-interested people who have perfect self-control, all acts of defection where the costs of retaliation outweigh benefits would go unpunished. An angry person, however, seldom gets recognized as a rational one, leading to an increase in the credibility of his threat of punishment, and thus decreasing the expected benefits of defection

in the first place (Frank, 1988).

### 1.2.1 Separating ultimate and proximate explanations

When attempting to construct an evolutionary explanation for any kind of behavior, it is important to separate parallel explanations on at least two different levels of causality, the proximate and the ultimate level (Mayr, 1961). *Proximate explanations* identify environmental stimuli that trigger mechanisms within the individual as the causes of physical expression of the behavior. For example, in answer to the question, "why do songbirds sing?", one might argue that increased daylight in the spring leads to increased testosterone production which activates parts of the brain in male songbirds. This explanation identifies a proximate mechanism (a neurobiological one in this case) in response to a direct stimulus (increased sunshine) to explain behavior (singing). Such a proximate explanation, however, might leave one with a sense of unsatisfied curiosity.

In order to answer why such a proximate mechanism came to exist in the first place, one needs to look for an *ultimate explanation*, on a more general level of evolutionary causation. The reason why male songbirds sing is that singing attracts females and defends territory from other males. Consequently, those males who sing have better chances of reproducing and spreading their habit of singing into the next generation of songbirds, than those males who do not sing. Such an ultimate theory has the advantage of explaining behavior, while at the same time encompassing and justifying the proximate explanation.[3]

### 1.2.2 How evolutionary theory helps to explain seemingly irrational behavior

There are at least three systematic[4] ways in which evolved behavior may depart from the seemingly rational. The first two result from the fact that ultimate functions are implemented through proximate means, and the third is based on fundamental constraints on information processing.

Proximate mechanisms are always imperfect in the sense that they were the first solution, discovered randomly by natural selection, which addressed a specific problem of survival and reproduction in the simplest and most cost-efficient way in a certain environment. As soon as there is a change in the environment, a proximate mechanism can easily lose its efficiency or even turn

[3]Ultimate (also called holistic) explanations are subject to criticism by reductionists who claim that because ultimate explanations are functional, they lack a sufficient causal argument. We provide a counterargument to this criticism in Chapter 7, page 137.

[4]By "systematic" we mean that behavior fails to be rational in the same way within the same context for a large number of individuals, i.e. not as isolated occurrences of some random or transient mistake in individual reasoning.

against the individual. Consider in the previous example the appearance of a human hunter who learns to imitate the calling of the male bird and thus easily captures female birds. In this case, females who have evolved a preference for males' songs experience a serious decrease in their survival and reproductive chances. By definition, proximate mechanisms lead to stable behavior across different contexts. But while they create a clear adaptive advantage in one context, they could lead to maladaptive behavior in another.

The first possibility for such errors is that a stimulus from the environment is falsely interpreted by the individual as a trigger for a proximate mechanism (a "false positive", or "type I error" in statistics). The reason why the proximate mechanism could still be left in place by evolution is that the relative cost of the false alarm is smaller than the cost of not recognizing the real stimulus (a "type II error"). According to Error Management Theory (Haselton and Buss, 2000; Haselton and Nettle, 2006), humans acquired a large number of biases that increase the amount of false positives, when false negatives are extremely costly. An interesting example is that people develop a strong aversion to a certain kind of food, if its consumption was closely followed by sickness in the past (Garcia et al., 1966). This mechanism protected ancestral humans against consuming poisonous food sources (cf. Sripada and Stich, 2004). Such behavior could also be regarded as rational if information collection and processing are assumed to be costly. Therefore, the departure from standard rationality in this case is not so much the crude causal approximation between poisonous food and sickness but the fact that the aversion is manifest as a discomforting sensation in the gut, and not as the end-product of a deliberative thought process.

An example with regard to interpersonal commitment is the laboratory studies carried out by Lawler and collaborators (Lawler and Yoon, 1993, 1996; Lawler et al., 2000). In these experiments, people became committed to their partners and reaffirmed their commitment with costly gifts when in fact they had never met these partners face to face and were ensured by the experimental setting that they never would. In this case, the bias for interpersonal commitment, a proximate mechanism, *misfired* in an inappropriate context (terminology from Sripada and Stich, 2004).

The second way in which rationality could fail is when a signal is correctly recognized but the response given to it is no longer adaptive due to changes in the environment itself. A core assumption of evolutionary psychology (Cosmides, 1989; Barkow et al., 1992) is that the environment we live in today is radically different from the environment of evolutionary adaptation (ancestral environment). Therefore, some of the evolved stimulus-response mechanisms have become maladaptive.

An example from the domain of interpersonal relationships is the very recent phenomenon of Internet addiction taking place among a worryingly large portion of ordinary people. The majority of these people turn to on-line chat

rooms and role-playing games in search of social support, sexual fulfillment, and an opportunity to safely express forbidden aspects of their personalities. Adverse results include social withdrawal in the real world and loss of control, which are typical of other forms of addiction (Henry et al., 1997). In other words, people follow their evolved need for socialization but given the transformation of our social environment due to rapid technological development, the individual's fitness is negatively affected.

The third way in which human decision-making may depart from rationality is linked to information. In order to make rational decisions by choosing between different actions that lead to different outcomes, one needs information about these outcomes. If evolution ultimately favored rationality, it would also have favored mechanisms that help to obtain and process information accurately. There is mounting evidence that evolution sometimes works in the exact opposite direction. This is most notable in the case of evolved cognitive biases and optical illusions (see e.g. Haselton and Buss, 2000; Haselton and Nettle, 2006; Gigerenzer and Todd, 1999). Among the numerous examples, consider Evolved Navigation Theory. According to this theory, humans were selected to perceive physical characteristics of the environment (e.g. height and altitude) not as precisely as possible, but rather with a factoring in of the dangers they represent for individual fitness. Researchers in an experiment (Jackson and Cormack, 2006) asked one group of people to estimate the height of a very tall lookout point by looking at it from its bottom and another group to do the same from the top. It was found that people on the top consistently overestimated altitude, *in proportion to the increased risk of falling*. This shows how evolution can build safeguards into our cognitive apparatus that act against standard rational calculation.

Consider now the finding of Johnson and Rusbult (1989) from earlier in this chapter, which shows that people systematically underestimate alternative partners, the more committed they are. If evolution ultimately favored the choice for a rational decision, it would have made sure that information about alternative partners is as accurate as possible at the time of making a decision. If, however, evolution aimed at stabilizing interpersonal commitments, it would have biased decisions in exactly this direction.

### 1.2.3 Constructing an ultimate explanation for interpersonal commitment

Although in his 1988 book Frank sets out to summarize empirical support for an evolutionary explanation for commitment in the general sense, many of his examples are more relevant for commitment in the interpersonal sense. Frank refers to marriage as a key example for a commitment dilemma. People search for the perfect mate, but settle for someone after a certain period of exploration despite knowing that there is certainly someone else out there, not

yet encountered, who would make a better spouse. And although a marriage contract may create a formal token of commitment, this is hardly the reason why people stop exploring further mates. A far more secure commitment is ensured by emotional bonds of affection (Frank, 2001). These emotional bonds ensure that even if someone kinder, better looking, or richer, *who would originally have been preferred over the current partner*, comes along now, the threat to the current commitment is diminished.

But what does this have to do with evolution? There is growing acceptance among biologists of the idea that marital commitment is a key factor in enhancing the reproductive success of humans (Hrdy, 1999; Martin, 2003; Foley, 1996; Geary, 2000; Pillsworth and Haselton, 2005), indeed more so than in the case of any other primate species. In order to be able to pass through the birth canal of their mother with their large brain unharmed, human infants need to be born at an earlier developmental stage than other primate offspring (Hrdy, 1999). Consequently, they are more helpless and require substantially longer parenting (Martin, 2003). Therefore, finding a committed father who is present and cooperative during this extended period of parenting is instrumental for the reproductive fitness of humans[5] (Foley, 1996; Geary, 2000; Pillsworth and Haselton, 2005).

Indeed, there is a wealth of empirical findings in psychology and social psychology that gives further support for the existence of a consistently biased emotional-cognitive framework facilitating interpersonal relationships and commitment (cf. Baumeister and Leary, 1995). People in every society on earth belong to small primary groups that involve face-to-face, personal interactions (Mann, 1980). Festinger et al. (1950) found that mere proximity is enough for people to develop social bonds, and is especially suitable to compensate for differences in age or race (Nahemow and Lawton, 1975). Ostrom et al. (1993) showed that people memorize things related to close acquaintances on a person basis, whereas information related to looser contacts is stored and organized based on attribute characteristics (e.g. traits, preferences and duties).

There is evidence that forgiving a misconduct of a committed partner directly enhances psychological well-being of the one who forgives (Karremans et al., 2003). It has also been shown that when people evaluate potential alternative partners, they unconsciously devalue potential alternatives the more committed they are to their current partner (Johnson and Rusbult, 1989). Kiyonari and Yamagishi (1996) give experimental support that those who stay committed to steady partners not only increasingly trust their partner, but

[5]Indeed there is a possibility that next to natural selection, sexual selection also contributed to the proliferation of a commitment trait. Since human women need to find potentially committed mates to ensure the survival of their offspring, showing interpersonal commitment in social relationships in general could have served as a costly signal of males' willingness and ability to become committed fathers.

also increasingly distrust outsiders, leading to a "vicious cycle of distrust in outsiders".

On the one hand, a strategy of commitment appears to be efficient in forging beneficial relationships, yet it also loses out by letting potentially good alternatives slip away, and moreover, it gives way to exploitation within the relationship. To better understand these mechanisms and their interaction under a complex, evolutionary dynamic, we create formal (computational) models of the ancestral environment. Our models for the evolution of deeply rooted emotions underlying interpersonal commitment rely on a series of previous works by Henk de Vos and his collaborators (de Vos and Zeggelink, 1997; de Vos et al., 2001; Zeggelink et al., 2000). These researchers designed an agent-based computational model based on the following minimalistic assumptions about conditions of the ancestral environment:

1. People lived together in relatively small groups.
2. The environment was harsher, its impact less buffered, and resources more scarce than today.
3. In lack of many modern social institutions, help from fellow individuals was more important for survival than today.
4. The environment and subsistence technologies were more stable over an extended period of time than in modern civilizations, which made it possible for evolutionary pressures to hardwire preferences.

De Vos and colleagues created a help exchange model, in which members of a relatively small group are dependent on the help of others to survive an event of distress from time to time. They compared two major contestants in their simulations of the evolution of exchange strategies, a strategy based on calculative reciprocal cooperation and a strategy based on commitment. De Vos and collaborators found that when each of the strategies competes against opportunistic players – i.e. actors who are unwilling to help but accept help from others – commitment is more viable than calculative reciprocity.

De Vos et al. tentatively concluded from their computational experiments that under conditions of the human ancestral environment, selection pressures might have shaped a tendency towards commitment and largely unconditional cooperation. This tendency may still be present in contemporary humans, even though the pressures that formed it are weakened or no longer in place. However, their studies were strictly limited by the small number of strategy variations they examined. This presents a problem because overly cooperative agents following a commitment strategy could easily fall prey to smart cheaters, a possibility that their model could not account for. Moreover, as Binmore (1998) argued forcefully, the outcome of computer tournaments and simulations of evolutionary dynamics strongly depends on the set of strategies that are initially present in a population.

To address whether and to what extent these two potential problems reduce the viability of commitment, we propose in Part I (Chapter 2) a method to considerably and systematically enlarge the set of behaviors examined in the original analysis of the help exchange model. The core idea is to represent behaviors as determined by a set of individual preferences, or traits with respect to possible exchange outcomes. Agents in our model are boundedly and subjectively rational in the sense that they make decisions to cooperate, defect and change partners with the goal of maximizing subjective utility (or satisfaction) given their preferences. However, maximizing subjective utility based on individual preferences in our model does not necessarily lead agents to optimal exchange outcomes. We assume that individual preferences or strategies are subject to evolutionary pressure that selects for successful strategies based on the objective fitness consequences of the behavior resulting from the strategy. This approach is similar to the "indirect evolutionary approach" proposed by Güth and Kliemt (1998).

### 1.2.4 Proximate mechanisms for interpersonal commitment

Is there support for an ultimate explanation for commitment through a corresponding *proximate mechanism*? More precisely, do contemporary humans have a stable, hardwired tendency to become committed to their previous interaction partners in an emotional way when it is not in their instrumental self-interest? In Chapter 5 we empirically test the existence of such a potentially hardwired tendency for commitment through a series of cross-cultural laboratory experiments.

When arguing for the evolutionary origins of any aspect of sociality, it is usually better to rely on cross-cultural data, in order to rule out cultural explanations. Since the environment of evolutionary adaptation mostly predates the break-up of modern cultures, adaptations associated with the ancestral environment should be present in all cultures. This is not to say, of course, that a cross-culturally stable phenomenon necessitates an evolutionary explanation, or that a lack of cross-cultural evidence rules one out. Culture intricately interplays with how people decide and behave, which itself has implications for biological evolution (Boyd and Richerson, 1985).

The idea behind a proximate explanation for commitment is that through repeated positive interactions, people's view of a committed relationship becomes systematically biased in comparison with a strictly instrumental perspective. When the relationship later takes a negative turn, this positively biased perspective for commitment makes stay behavior and cooperation more likely than otherwise expected. According to the mere exposure effect (originally described by Zajonc, 1968), when being repeatedly subject to a non-repulsive stimulus, one develops a positive affect toward the stimulus. For example, the more we listen to the same piece of music, the more we appre-

ciate it. We argue that such a mere exposure effect exists between long-term interaction partners. There is evidence, for example, that the more we see the same face, the more attractive we find it (Rhodes et al., 2001). What is even more interesting, is the finding that people also *trust* others more if they have been exposed to them more times, even in the absence of any interaction that could support actual inferences about trustworthiness (Moreland and Beach, 1992).

## 1.3 Methodology

Studies reported in this volume rely largely on two key methodological approaches, agent-based computational modeling and laboratory experiments. Below is a brief description of both, and an explanation of their usefulness for answering our research questions.

Part I is aimed at testing an evolutionary theory that posits the stabilization of a commitment trait under selection pressures of the human ancestral environment. Its goal is to compare the strengths and weaknesses of commitment to other social preferences, such as calculative reciprocity (fairness). Drawing on earlier work in this domain (de Vos et al., 2001) and weighing the complexity of the modeling task, we decided to apply a type of social simulation to our problem, agent-based computational modeling (ABCM).

Whereas social scientists usually model social processes as interactions among variables, ABCM studies interactions among adaptive agents who influence one another in response to the influence they receive (Macy and Willer, 2002). In ABCM, all modeling information about the properties of individual agents and their behavioral rules are transformed into a formal language (e.g. a computer program). Subsequently, the dynamics of the model, as well as conclusions on the macro-level can be deduced through step-by-step computation from given starting conditions (Flache and Macy, 2005). The advantages of ABCM are especially apparent when modeling dynamic phenomena in groups that are highly complex, non-linear, path-dependent, and self-organizing. The obvious advantage is that the explanation draws on local interactions among agents and not on predefined global characteristics of the group (Macy and Willer, 2002).

A possible alternative methodology in Part I would be game theoretical (e.g. equilibrium) analysis. The benefit of such analysis is that it is able to provide more universal hypothesis tests that benefit from the strength of a mathematical proof. Its drawback is that given the complexity of our model, coupled with the evolutionary dynamic, this methodological approach seems unfeasible. This is also illustrated by the relative complexity of a brief analysis of a strongly simplified version of our model in Appendix A.

In Part II, we aim to empirically test the evolutionary argument through

identifying peculiarities in decision-making in exchange relationships among contemporary humans. The majority of our hypotheses predict links between specific, well-defined conditions and exact, quantifiable measures of commitment. Therefore, strict control over conditions and measurement is indispensable. Accordingly, we decided to test our hypotheses in laboratory experiments with human subjects, using anonymous, computer-based settings.

A possible alternative here would be to rely on representative cross-national surveys, or data collected among contemporary small-scale (e.g. hunter-gatherer) societies. Such secondary data analysis, however, would seriously restrict the scope of hypotheses that we could test.

## 1.4 Outline of chapters

The rest of this dissertation is organized as follows. Part I lays the theoretical foundation for studying interpersonal commitment using formal computation models. These three chapters investigate whether a commitment trait could have been adaptive under the conditions of the ancestral environment, with each chapter gradually putting commitment under a stricter test. More specifically, Chapter 2 examines whether improving on a known weakness of fair reciprocity (the main contestant of commitment in earlier work of de Vos et al., 2001) eliminates the competitive advantage of commitment. We create an agent-based model that is capable of incorporating previous models, and at the same time offers more flexibility and robustness to study the relative viability of commitment strategies. This chapter also tries to answer whether the exchange network structures, which are formed spontaneously in the simulated populations, help to explain the relative differences in viability.

Chapter 3 puts the viability of commitment strategies under a stricter test by extending the previous ecological model through accounting for evolutionary dynamics of selection and mutation. This also means that the strategies examined here are no longer *a priori* invented and specified by the modeler, but emerge spontaneously through random walks in the strategy space. In comparison with previous work, this can possibly lead to the emergence of more sophisticated opponents that may take advantage of the weaknesses of commitment.

A defining characteristic of interpersonal commitment is that one forgoes interaction with potentially better alternatives in favor of a long-term partner. Chapter 4 puts the emphasis on inequalities between potential interaction partners, and asks whether a preference for high-resource (or highly capable) others is more important than a preference for old partners (commitment). It also examines whether becoming committed to average or low-value partners undermines the efficiency of commitment. In order to do so we extend our previous model by introducing an inheritable trait for high-resource others,

and non-inheritable inequality in individual capabilities/resources.

Part II turns to the experimental investigation of whether an ancestrally evolved commitment trait influences behavior in contemporary humans. Chapters 5 and 6 examine commitment in various exchange situations using laboratory experiments with human subjects. These two chapters take up the two major lines in explaining commitment in exchange: positive emotions and uncertainty reduction. In Chapter 5, we study whether people have a tendency to escalate commitment to previous interaction partners, when it is not in their self-interest. The purpose of this study is to test whether people have a cross-culturally stable emotional preference for previous partners that acts as a decision-making bias even in anonymous, economic setting. At the same time, in Chapter 5 we also find that uncertainty can *decrease* commitment, which leaves us with a new puzzle.

To resolve the puzzle about the effect of uncertainty on commitment, in Chapter 6 we propose to refine the explanatory framework that has been used in the literature of commitment in exchange. More precisely, we identify an important assumption that previous works have left implicit, about the cooperative intentions of people, that qualifies the effect of uncertainty on commitment. In addition, Chapter 6 is also an empirical counterpart of the theoretical Chapter 4, which argued that a preference for previous partners (commitment) should be stronger among contemporary humans than a preference for high-resource partners. Accordingly, we argue that partner selection situations can create not only social uncertainty (about trustworthiness) but also resource uncertainty, and that each type of uncertainty has its independent effect on commitment. At the same time, we contend that individual characteristics, such as general trust and optimism, may also influence the level of commitment.

Finally, Chapter 7 contains a summary of results, with a general discussion of the findings, and an evaluation of the strengths and weaknesses of the work accomplished. We locate our work within past research and point to possible avenues of future research.

Since Chapters 2, 3 and 4 have been accepted for publication in international peer-reviewed journals and a book, and the material that makes up Chapters 5 and 6 is currently under review, these chapters are kept in their original article format. As a result, some overlap may be detected between different chapters, especially in their empirical motivation and model descriptions. On the positive side, this leaves each chapter stand-alone and self-explanatory.